



# **Towards an Adaptive Management Approach to Non-compliance in National Park Service Units**

Natural Resource Report NPS/NRSS/BRD/NRR—2016/1125



**ON THE COVER**

Photograph of visitors at Rocky Mountain National Park on Alpine Ridge Trail standing off-trail next to a sign that says "Fragile Tundra, Stay on Trail."

NPS Photo by Kirsten Leong.

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# Introduction

In an effort to protect social and physical environments from the impacts of human behaviors, protected area managers often implement rules and regulations that outline acceptable behaviors in parks. Behaviors that are in violation of these rules and regulations (whether or not their existence is known by the perpetrator) are referred to as non-compliant behaviors. Such non-compliant behaviors are serious concerns to managers of protected areas because of their potential negative impacts on cultural resources, infrastructure, other visitors, and natural resources (Christensen, 1986; Clark, Hendee, & Campbell, 1971). In this literature review, we specifically focus on non-compliant behaviors that affect natural resources. First, we review broad classes of human behaviors that impact natural resources and, more specifically, categorize human behaviors that are non-compliant. Second, we outline different motivations for compliance and non-compliance (i.e., what drives human behavior). Third, we discuss current methods used to detect and monitor non-compliant behaviors in various contexts worldwide. Fourth, we summarize different avenues for addressing non-compliance, including the associated challenges with implementing such approaches. Finally, we suggest an adaptive management framework for identifying, tracking, and addressing non-compliance to help parks and protected areas managers reduce such activity.

## **The importance of natural resource compliance**

Compliance with rules and regulations is critical to natural resource management, because rules and regulations are typically enacted and enforced as a means to maintain ecosystem services and reduce deleterious effects of human behaviors. These effects can include habitat alteration or destruction, biodiversity loss, decreased ecosystem function, and a whole range of impacts on specific natural resources (e.g., soil compaction, decreased water quality, wildlife habituation, deforestation), as well as on the enjoyment of these resources by others. Reducing the negative impacts on natural resources are important considerations for parks and protected areas managers whose aims include maintaining biodiversity and conserving threatened species. Furthermore, many communities local to parks and protected areas may depend on those same resources for their livelihoods, subsistence, and recreation or psychological benefits. Such dependence adds an additional layer of complexity to the range of who is impacting resources as well as who is impacted by non-compliant behaviors. For example, activities that are typically illegal in parks, such as harvesting of ginseng root or rare orchids, can have positive economic impacts on local communities, while overharvesting can result in species loss (a concern to managers of this resource) and negative economic impacts to communities that suffer due to declines in abundance of that resource (e.g., Luken, 2005; Nantel, Gagnon, & Nault, 1996; Subedi et al., 2013).

In addition, the scales at which costs and benefits of non-compliance are realized frequently do not match (Keane, Jones, Edwards-Jones, Milner-Gulland, 2008). This scale mismatch means that the repercussions of performing non-compliant behaviors may be quite severe (e.g., jail time, monetary penalties) or broadly directed (e.g., extensive exclusions from protected area) rather than targeted at the specific individuals performing the behavior. The wide-range of impacts and potential groups of people that may be affected by non-compliance underscores the importance of having a common language from which the extent of the problem can be discussed. In order to facilitate this discussion,

and subsequently, research on and solutions to non-compliant behaviors, we offer a standard lexicon of human behaviors as they apply to a natural resources context. This effort acknowledges that compliance and non-compliance have been researched under many different names in the past, including depreciative or deviant behaviors, illegal or illicit behaviors, and pro-environmental or pro-social behaviors.

### **The National Park Service**

Many of the non-compliance issues faced by the United States National Park Service (NPS) are similar to issues faced by managers of parks and protected areas globally, making the NPS an excellent example from which to explore non-compliance. Furthermore, NPS is one of many institutions committed to addressing non-compliant behaviors in an effort to meet conservation goals. Close to 300 million people annually access more than 84 million acres of NPS lands (<http://www.nps.gov/faqs.htm>). This volume of visitation can have significant impacts on natural resources, including impacts to soil, vegetation, wildlife, water, air, soundscapes, and night skies (Manning & Anderson, 2012). Specifically, Johnson and Vande Kamp (1996) found that 772 frontcountry (e.g., trailheads, historic sites) and 185 backcountry sites (e.g., scenic overlooks, camping sites, trails) at reporting NPS units were affected by non-compliant behaviors, causing approximately \$79.2 million in estimated costs for repairs and maintenance<sup>1</sup>. Examples of non-compliant behaviors performed on NPS lands and waters include poaching of wildlife and plant species, stealing and collection of petrified wood, harvesting edibles such as mushrooms and berries out of season or without a permit, camping in prohibited areas, feeding of wildlife, and use of off-highway vehicles in wilderness areas.

To further explore the range of non-compliant behaviors affecting natural resources within the Park Service, we conducted 16 semi-structured interviews with NPS staff. These interviews followed an initial review of relevant documents (e.g., PMIS reports, Technical Assistance Requests, law enforcement records) available to Park Service personnel that indicated additional information would aid understanding of non-compliance within the Park Service. Results of these interviews are incorporated into this report through the provision of examples and quotes, where appropriate. The interviews provided context as to the range of non-compliant behaviors occurring, and the myriad efforts employed by NPS staff and their partners to address human behaviors. Interviewees were NPS staff who represented parks in their respective geographic regions or who worked at the national level and had experiences with multiple parks. Each person interviewed was asked to think about the questions posed to them from his or her range of Park Service experiences.

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<sup>1</sup> As defined by Johnson and Vande Kamp (1996, p. 131), noncompliant behaviors do *not* include “major acts of vandalism and acts motivated by criminal intent.” Therefore, costs of damages incurred by the full range of noncompliant behaviors would be higher. Additionally, costs reported here are for the time in which they were calculated rather than today’s dollars.

## Classes of Human Behaviors

Numerous human behaviors have been identified in the literature as having the potential to negatively impact natural resources, with some behaviors (e.g., illicit wildlife trafficking) receiving heightened attention due to their well-publicized impacts on resources (WWF, 2012). Advancing a classification of general human behaviors that can negatively impact natural resources (whether or not such behaviors are non-compliant) is critical, since such classification can increase our ability to refer to the threats to biodiversity posed by these behaviors and ultimately aid in the success of conservation efforts (Salafsky et al., 2008). The classification outlined in Table 1 is an appropriate starting point for identifying and understanding the range of human behaviors that negatively impact natural resources. Many other typologies exist that have common overlap with the classification provide here (e.g., Crow, Shelley, & Stretesky, 2013; Forsyth, Gramling, & Wooddell, 1998; Glover & Baskett, 1984; Gregorich, 1992; Muth & Bowe, 1998; Stoll, 1975; White, 2008). However, we present this classification because it describes the range of human behaviors that tend to occur specifically within NPS units.

**Table 1.** Identifying classes of general human behaviors and potential impacts on natural resources<sup>1</sup>.

Classification	Example human behavior	Example impacts
Unavoidable actions	Disposal of human body waste	Impacts to wildlife, decreased soil/water quality
	Loss of ground cover vegetation in a campsite	Vegetation loss, soil compaction
Uninformed actions	Selecting a lightly used campsite in wilderness	Vegetation loss, soil compaction
	Building cairns along trails	Vegetation loss, soil erosion
	Using dead snags for firewood	Destruction/loss of resources
Unskilled actions	Selecting inappropriate camping site	Vegetation loss, soil compaction, impacts to wildlife
	Building improper campfire	Destruction/loss of resources
Careless actions	Littering	Impacts to wildlife
	Nuisance activity (e.g., shouting)	Impacts to wildlife
Illegal ( <i>deliberate behaviors</i> )	Theft of cultural artifacts/natural resources	Destruction/loss of resources
	Poaching	Destruction/loss of resources
	Invasion of wilderness by motorized off-road vehicles	Destruction/loss of resources

<sup>1</sup> The classifications and human behaviors listed draw upon available literature, and, in particular, the work of Hendee, Stankey, & Lucas, 1990; Roggenbuck, 1992; Vander Stoep & Roggenbuck, 1996; and Manning & Anderson, 2012.

With this typology, human behaviors are categorized as actions that are unavoidable, uninformed, unskilled, careless, and illegal. This particular classification attempts to identify how people perform specific behaviors rather than focusing on the underlying motivations. This is an important distinction, as there may be different reasons why different groups of people perform a particular behavior. For example, stealing petrified wood, an illegal activity in Petrified Forest National Park, can be the result of uninformed action by a group of visitors who are unaware of the consequences of their actions. Alternatively, stealing petrified wood could be a deliberate illegal action for a specific purpose such as resale. These categories of noncompliant behaviors are not mutually-exclusive, which has implications for the effectiveness of methods for addressing behavior. An informational brochure distributed to people deliberately performing illegal behaviors will have little effect on changing that behavior, while such management response could be successful at deterring others who were unaware (but still concerned) that their behaviors would negatively impact resources (Manning & Anderson, 2012). We discuss methods for addressing behaviors and the effectiveness of those methods in a later section of this report.

The first classification, unavoidable actions, relates to those human behaviors which cannot be appropriately accomplished elsewhere due to spatial or temporal limitations. One example would be an individual hiking a steep trail alongside a river who deposits human waste within 200 feet of that river (i.e., a violation of Principle 3 of Leave No Trace ethics; <http://lnt.org/learn/principle-3>). This would be considered unavoidable in the sense that humans must eventually dispose of their waste. Such actions are performed without specific intent to harm or affect natural resources, and these behaviors occur more often than not because of poor resource design (e.g., lack of appropriately-placed bathroom facilities) (Manning & Anderson, 2012). Managers and planners should carefully consider the potential for high visitor use of certain areas, in addition to the types of impacts visitors could have on resources during that recreational use.

The second category of human behavior that can negatively impact natural resources includes actions which are uninformed. Uninformed actions are performed by people who lack knowledge regarding what is appropriate behavior or lack awareness of the impacts of their behaviors. As one illustration of an uninformed action, visitors following rock cairns (e.g., piles of rocks) constructed by other visitors in Acadia National Park led to significant soil compaction and erosion (Jacobi, 2003). Whereas some of the visitors may have seen others performing the behaviors and been motivated to follow (see the later section on social norms), other visitors may have been unaware of the impacts of their behavior on park resources. As another example of an uninformed action, visitors who use dead snags for firewood may unknowingly cause localized impacts to soils and vegetation, which can leave campsites barren of future sources of shade, soil nutrition, and woody debris (Hammitt & Cole, 1998). These types of actions seem appropriate to the uninformed visitor who does not know their behaviors will have negative impacts on resources. These types of actions are most problematic when also constituting illegal behaviors (e.g., picking up “rock” souvenirs that happen to be petrified wood).

Third, human behaviors can be classified as unskilled actions. Such behaviors are performed when people do not have particular expertise that is in accordance with best practices, rules or regulations.

Examples of actions that are unskilled could include selecting an inappropriate camping site or building an improper campfire. These types of behaviors can have both direct and indirect impacts on natural resources (e.g., soil compaction, resource destruction, disturbance of wildlife). Unskilled actions are similar to uninformed action in that they are performed by visitors without intent to do resources harm. People are either currently incapable of (i.e., unskilled) or are uninformed about the appropriate behaviors (i.e., have the skills but do not know they should use those skills in a particular situation).

Fourth, behaviors that can negatively impact natural resources may be actions that are careless. Examples include littering, boisterous behavior such as shouting, and the use of informal social trails. Informal social trails are unsanctioned paths used by hikers, climbers, or other recreationists wishing to access points of interest outside of designated trail systems. These social trails can cause disturbances to wildlife, bird, and plant species; soil compaction; loss of vegetation; small-scale habitat fragmentation; and non-native species introduction (e.g., Barros, Gonnet, & Pickering, 2013; Knight & Cole, 1991; Leung, Newburger, Jones, Kuhn, & Woiderski, 2011; Marzano & Dandy, 2012; Richardson & Miller, 1997). Boisterous behaviors, such as children yelling along a trail in excitement or individuals blaring radios while camping, may adversely affect birds and other terrestrial wildlife. The effects of chronic noise in protected areas would be important to monitor so that long-term impacts of such careless action could be assessed (Barber, Crooks, & Fistrup, 2009). Actions are “careless” when people know the behaviors are inappropriate, whether or not they specifically know the potential impacts of their behavior on natural resources, but disregard that knowledge for sake of convenience or personal benefit.

Finally, human behaviors can be classified as illegal. Most deliberately-performed non-compliant behaviors by definition fall into this category, and examples are numerous. Generally, these actions can be grouped into one of two categories: “actions against nature” (e.g., behaviors that endanger species other than humans) or “actions against humanity” (e.g., behaviors that endanger humans) (Table 2). Clearly there can be overlap between these categories. For example, poaching, categorized as an action against nature, can also negatively impact local economies that are dependent on those resources for tourism and wildlife-dependent recreation (e.g., hunting, fishing, wildlife viewing). Additionally, some activities can fall into either category depending on the context. Exceeding speed limits on busy thoroughfares in a heavily visited National Park is an action against humanity, but exceeding speed limits in waters containing federally-protected West Indian manatee (*Trichechus manatus latirostris*) off the Florida coast is an action against nature (Jett, Thapa, & Swett, 2012). As another example, off-leash dog-walking in parks and protected areas can threaten other humans and negatively impact wildlife (Hughes & Macdonald, 2013; Tardona, 2012). We use these two broad categorizations because they serve to differentiate the primary targets of behavior. In the example of poaching, the direct impact is on the target species being poached with indirect effects occurring on species, human and otherwise, that are reliant on the target species. For actions against humanity, natural resources are not the primary target of human behaviors, but may be directly or indirectly affected.

**Table 2.** Classifying illegal behaviors that negatively impact natural resources.

General classification	Specific category <sup>1</sup>	Target species and/or example behaviors
<i>Actions against nature</i>	Harvesting <sup>2</sup>	<ul style="list-style-type: none"> <li>• Edibles (e.g., berries, mushrooms)</li> <li>• Plant species (e.g., flowers, rare orchids, medicinal leaves)</li> <li>• Collectables (e.g., shells, abalone, shark teeth, antlers, petrified wood)</li> <li>• Live animals</li> <li>• Timber products/deforestation</li> </ul>
	Poaching	<ul style="list-style-type: none"> <li>• Killing fish/wildlife with illegal means (e.g., snaring, gill nets, poison)</li> <li>• Illegal fishing/hunting (e.g., out-of season, in-excess of bag limits, in prohibited or undesignated areas, without required permit/license)</li> </ul>
	Human-wildlife interactions	<ul style="list-style-type: none"> <li>• Wildlife feeding</li> <li>• Touching/petting/approaching wildlife</li> <li>• General wildlife harassment (e.g., dogs off-leash)</li> </ul>
	Careless behaviors	<ul style="list-style-type: none"> <li>• Littering</li> <li>• Exposed food attractants (e.g., improper food storage)</li> <li>• Exceeding speed limits in protected manatee waters</li> </ul>
	Resource damage	<ul style="list-style-type: none"> <li>• Carving on trees, painting/graffiti on rocks</li> <li>• Driving boats through seagrass</li> </ul>
	Non-sanctioned uses	<ul style="list-style-type: none"> <li>• Off-trail use or “social” trails</li> <li>• Camping in closed areas</li> <li>• Motorized use (e.g., ORVs, OHVs, ATVs) in non-designated areas</li> <li>• Use of non-lead bullets/tackle when required</li> </ul>
<i>Actions against humanity<sup>3</sup></i>	Firearms	<ul style="list-style-type: none"> <li>• Target practice shooting outside of designated areas</li> </ul>
	Illicit drugs	<ul style="list-style-type: none"> <li>• Growing marijuana</li> <li>• Meth production</li> </ul>
	Non-sanctioned behavior	<ul style="list-style-type: none"> <li>• Exceeding speed limits</li> <li>• Debauchery (e.g., excessive public intoxication, “party” boats)</li> </ul>

<sup>1</sup> While some of these categories (e.g., harvesting, human-wildlife interaction, firearms) and behaviors (e.g., hunting/fishing, off-trail use, target practice shooting) are not explicitly illegal, they are referred to here specifically when such behaviors are non-sanctioned and/or in violation of rules, regulations, and best practices.

<sup>2</sup> During interviews with NPS staff, some people referred to “harvesting” of plant resources as “poaching” to underscore the severity of resource loss due to such actions (e.g., “harvesting” may also denote acceptable use under certain conditions, while “poaching” typically does not). We note that, as defined here, both actions constitute illegal take with negative consequences to natural resources; therefore, both categories are of equal concern when managing non-compliance.

<sup>3</sup> Property crimes (e.g., larceny, theft, burglary, arson) and violent crimes (e.g., murder, rape, human trafficking), which are clearly actions against humanity, can also have negative impacts on natural resources. They are not listed here, because such actions are typically prosecuted under different laws than are natural resource-related infractions.

## Motivations for Performing Non-compliant Behaviors

Non-compliant behaviors have been defined as “goal-directed forms of transaction with the environment” (Knopf & Dustin, 1992, p.210), suggesting that people have reasons for doing what they do in regards to natural resources. What, then, are the specific drivers of non-compliance? These drivers, or motivations, are necessary considerations when developing appropriate management responses since particular approaches may be more or less effective depending on what drives the behaviors. Furthermore, these drivers can occur at different scales (Keane, Jones, Edwards-Jones, & Milner-Gulland, 2008). For example, at the individual-level, drivers may relate to emotions, such as wanting to get closer to wildlife out of attraction and awe. At the group-level, drivers may be related to social norms, or who is doing what, which can encourage or discourage others from performing particular behaviors. Additionally, institutional-level drivers, such as which entity is managing or enforcing the rules and regulations, can affect the occurrence and severity of behaviors. An understanding of drivers at these different levels is important since individuals operate within these broader taxonomies. Many social science disciplines contribute to understanding what drives non-compliance, and these disciplines are noted below in the sections for which they have been most employed. However, it is important to note that there is often overlap between disciplines and the types of drivers the disciplines investigate. Furthermore, the literature may indicate the range of drivers that exists, but data collection is critical to determine which of potentially *multiple*-drivers may be at play in any given context. For particularly contentious cases of non-compliance, many if not all of the drivers listed below may be impacting behaviors and should be explored with rigorous sampling techniques. We discuss methods for detecting and assessing the range of drivers (outlined below) in the following section.

The work of Gramann and Vander Stoep (1987) on typing behavioral violations has direct application to parks and protected areas management. Similar to previous work on vandalism (e.g., Cohen, 1973; Wise, 1982; Martin, 1961), these researchers identify six categories of behavioral violations: unintentional, releaser-cue, uninformed, responsibility-denial, status-confirming, and willful. Some of these categories (e.g., unintentional and uninformed) were discussed in the previous section. Others are important to note for purposes of discussing motivations. *Releaser-cue violations* are those that occur because something in the social or physical environment makes the behavior seem “appropriate,” and people are essentially “released” from any preconceived idea of the behavior violating rules or regulations (Haney, Banks, & Zimbardo, 1973). Park visitors, for example, who see other visitors feeding small mammals at a scenic overlook, may then perform that same behavior because the behavior is occurring (or has left evidence of occurrence) directly in front of them. *Responsibility-denial violations* are those violations in which a person, who would be compliant otherwise, performs a specific non-compliant behavior in a situation for which there appears to be no other reasonable alternative. As an illustration, Roggenbuck and Berrier (1982) found that visitors arriving late in the evening at an overused meadow were much more likely to camp there despite the presence of signs indicating to camp elsewhere, while campers arriving earlier in the day heeded the signs. *Status-confirming violations* are those in which someone acts in accordance with particular group norms to enhance their own standing within that group. Spraying graffiti on rocks or carving on trees may be activities performed by members of a group as an assertion of their deviousness in

attempt to “fit in” with that group. Finally, *willful violations* are those motivated by reasons such as those discussed below and acted out under one’s own volition.

## **Individual-level Drivers**

### ***Economic/market incentives.***

Becker (1968), in his “economics of crime paradigm”, indicated that human behaviors are driven in large part by an assessment of costs and benefits. In such rational-choice theories, people seek out opportunities that provide gains up to the point when costs begin to exceed those gains (Akers, 1990). Similarly, people seek to avoid punishments such as fines and sanctions (Keane, Jones, & Milner-Gulland, 2012). Benefits and punishments can be nonmonetary as well, such as the “reward” of a scenic vista when using an informal social trail or being barred from entering a park for one year as a punishment for poaching. Rational-choice theories (e.g., deterrence theory) have received criticism for assuming that humans can accurately determine the best cost-benefit balance and act in accordance with that balance (Eggert & Lokina, 2009; Kuperan & Sutinen, 1998). Clearly, there is a limit to humans’ rationality and decisions are often influenced by contextual clues in people’s surroundings (Etienne, 2013; Pratt, Cullen, Blevins, Daigle, & Madenson, 2006).

For many protected area visitors, signs indicating the “costs” (i.e., consequences) associated with performing a particular behavior are enough to thwart that behavior. For other visitors, signs encouraging freedom of choice (a perceived “benefit”) may be particularly effective, because such signs amplify a benefit associated with performing a compliant behavior with no associated costs. As an illustration of this concept, Johnson and Vande Kamp (1996) describe a scenario in which visitors told to camp in a specific zone would be more compliant if they are also informed that they can camp anywhere they wish within that zone (i.e., the perceived benefit). Other individual-level behaviors may be driven by incentives, such as financial markets, that are outside of the control of natural resources managers. For example, animals can be poached or collected and sold for a variety of perceived needs and desires (e.g., gall bladders of black bears used in traditional Asian medicines; rare species collections such as threatened and endangered butterflies), while other animals may be illegally harvested and sold as part of the live pet trade. These types of economic drivers will continue to influence human behaviors until the price and demand for these species and related products is reduced to a level similar to or less than the fines for getting caught performing the behavior.

### ***Attitudes***

Attitudes are evaluations of a particular thing, person, place, or object with some degree of favor or disfavor (Eagly & Chaiken, 1998). Attitudes are extremely variable over time and context, and can have great influence over individuals’ motivation to comply (or not) with rules and regulations. For example, individuals who agree that hiking off-trail would damage natural resources and have a positive evaluation of the importance of those resources would be much more likely to abide by related rules and regulations than someone who does not think natural resources damage will occur. Individuals who do not agree with specific posted rules and regulations are much more likely to be non-compliant. As another example, someone may not agree that any potential damage caused by his or her action is severe enough to warrant concern (resulting in the behavior being performed).



Attitudes are often influenced by the knowledge a person has regarding the impacts of their behaviors, but rarely does knowledge alone promote compliance (Rajecki, 1982); a person has to agree or not with the knowledge they have acquired in relation to the situation at hand, and believe that they have control over their own behavior. As another example of how attitudes can play a role in driving behaviors, people are more likely to comply with rules and regulations if they trust the governing authority (Stern, 2008). If institutional enforcement is believed to be ineffective for controlling non-compliant behaviors (i.e., an individual is not “in favor” of the managing authority), then violations would be more likely to occur. Attitudes that are stronger and more salient in a given situation have greater influence over a person’s behaviors than attitudes that are weak (i.e., not well-formed) or not relevant to the given context.

### **Emotions**

Emotions (e.g., revenge, excitement, malice, shame, pride) also drive non-compliant behaviors. As one example, individuals ostracized by protected area boundaries or impacted by the protected status of particular wildlife species may participate in retaliatory killings of that species as a form of revenge (Chapron, Miquelle, Lambert, Goodrich, Legendre, & Clobert, 2008; Damania, Stringer, Karanth, & Smith, 2003; Ghate, 2003; Rastogi, Hickey, Badola, & Hussain, 2012). Similarly, humans may perform non-compliant behaviors out of malice. Behaviors carried out for purposes of fun or excitement, such as during a children’s game, can also result in non-compliance. Examples include children attempting to collect as many plants or animals as possible, or throwing rocks at natural resource targets or over cliffs. The purpose of the play itself is rarely to harm resources, but damage can occur. Shame, a feeling of losing favor in the eyes of others that is generally considered undesirable to have (Smith, Webster, Parrott, & Eyre, 2002), was shown to encourage greater compliance than pride (Panagopoulos, 2010), suggesting that people may perform specific behaviors (or not) in order to avoid feeling emotions that are perceived as negative to have.

### **Demographics**

Some researchers (e.g., Jensen & Aarset, 2008; Madrigal-Ballester, Schlüter, & Lopez, 2013) describe in the literature that demographics are an individual-level driver; however, we note that demographics are indicative of other drivers at play. For example, women may be more likely to harvest plants because women in many places have traditionally prepared food for their families. This behavior is not because women prefer collecting plants more so than men. As another example, Crow, Shelley, and Stretesky (2013) detail a number of studies suggesting that, in general, people involved in wildlife crime in Florida are young, white, male, poor, and from rural areas, while Carter (2006) found that women and ethnic minorities were more often cited for violating specific rules and regulations related to fishing (Carter, 2006). Demographics, therefore, can tell you something about a particular group of people who are *performing* certain behaviors, but they are not drivers of those behaviors.

Culture has also been associated with compliance rates. For example, Barrett et al. (2004) found that people from collectivist cultures (e.g., many Eastern societies, such as Japan, China, and India, are considered to be collectivist) were much more likely to follow social norms, or particular ways of being, than were people of more individualistic societies such as America. Rules and regulations that

highlight or reinforce collectivist cultural ideals could lead to higher levels of compliance with members of those cultures (Schouten, 2008). Certain strategies may encourage greater compliance with people from collectivist cultures, while other strategies may be more effective with people from individualistic cultures (Cialdini, Wosinska, Barrett, Butner, & Gornik-Durose, 1999). For example, Americans tend to use specific traits related to their personality to describe themselves, while members of Asian cultures are more likely to indicate a specific role they fulfill in a given context (“I am sincere” for Americans vs. “I am a university student” for collectivists; Petrova, Cialdini, & Sills, 2007). Therefore, signage highlighting social norms may be more effective for people of collectivist cultures and less effective in individualistic cultures.

## **Group-level Drivers**

### ***Social norms***

Norms are shared beliefs among a group’s members about what people are obliged, permitted, or forbidden to do. Norms can be broad ideals, such as justice, fairness, and morality, and they can have significant influence over human behaviors (Crawford & Ostrom, 1995; Henrich et al., 2006; Ostrom, 2000; Tyler, 1990). As an illustration of how norms have influenced natural resource compliance, Keane and his colleagues (2008) found that moral obligations led to increased compliance in small fisheries across several studies despite low levels of enforcement. Much of the literature on governance of common pool resources (i.e., limited quantity resources that can be subtracted from publically-available sources for profit; Ostrom, 1990) also identifies the importance of understanding the social context and norms surrounding natural resource compliance. Both sociologists and psychologists have contributed greatly to the study of norms because of the impact that norms have on influencing individual-level behavior and group dynamics. According to normative theories, rules and regulations that are not perceived as legitimate, fair, or efficient in terms of the regulatory process, are less likely to be followed (Hauck, 2008; Hønneland, 1999; Sutinen & Kuperan, 1999). Norms can be applied in economic models assessing whether people believe particular behaviors are socially acceptable or beneficial (Sutinen & Kuperan, 1999; Nielsen & Mathieson, 2003). Norms may also be exercised as forms of ideological protest. If people believe that their rights have been infringed upon, for example, by recent government closures of previously accessible areas, then those people may perform non-compliant behaviors as a form of objection (Lewis, 2013). Norms most often influence behaviors when there is a moral obligation to perform (or not) the behavior, a strong desire exists to please (or not) others, and rewards (or punishments) are made clear (Gramman & Vander Stoep, 1987). Norms have been studied across a variety of different settings within NPS units (e.g., Kuentzel, Laven, Manning, & Valliere, 2008), and are an important concept in the social sciences (Ajzen, 1991).

## **Institutional Drivers**

### ***Policies and infrastructure***

Compliance rates can depend on the institution defining and enforcing appropriate human behaviors. This notion is reflected in conflict control theory, which purports that non-compliant behaviors are defined by the policies of managing institutions (Christensen, 1986), and such policies may or may not be consistent with the desires and beliefs of visitors or local community members. Managing institutions can also be slow to change over time or be directed from a central authority that may

have little direct experience with on-the-ground realities (as noted by some NPS staff during interviews), resulting in policies that do not necessarily reflect current public thinking. Policies that are in discordance with public opinion may have greater rates of non-compliance.

Game theory has also been employed as a means for determining how relationships between enforcers of rules/regulations (e.g., game wardens) and offenders (e.g., poachers) have a reciprocal influence on non-compliant and enforcement behaviors (Andreozzi, 2004; Tsebelis, 1989). If non-compliant behaviors increase, then enforcement tends to increase. As enforcement increases, non-compliance most often decreases. However, in some cases, increased enforcement can “increase” non-compliance because behaviors are more readily detected and/or reported (e.g., Andreozzi, 2004). The managing institution’s capacity for addressing non-compliant behaviors plays a critical role in driving non-compliance, underscoring the importance of institution-level models for understanding this topic (Skonhoft & Solstad, 1998). As another example of how institutional structure may influence compliance, Stretesky, Shelly, and Crow (2010) found that a greater number of conservation organizations (rather than the number of hunting and fishing or animal rights organizations) increased the number of detected natural resources crimes. This result suggests that the presence of conservation-specific entities may help to reduce non-compliant behaviors over time due to an increased probability of detection as well as increased trust in the enforcing authority.

And, finally, the infrastructure of a managing institution may also play a role in driving behaviors. Certain unavoidable behaviors, such as needing to go to the bathroom or throwing away trash, are bound to happen if facilities or receptacles are not appropriately placed or available in times of need. Alternatively, as indicated by a few Park Service staff interviewees, parks could encourage compliance in specific situations by initiating guided-only experiences (e.g., on Grand Canyon river trips, in areas considered unsafe) to ensure that visitors follow appropriate behaviors as much as possible. In other cases, park staff can reduce non-compliant behaviors by removing incentives (e.g., past evidence of non-compliance, natural attractants) to perform the behaviors, and by stationing staff, volunteers, or law enforcement in areas of high impact (Johnson & Vande Kamp, 1996).

## Methods to Detect Non-compliant Behaviors

In order to better understand non-compliant behaviors, managers must be able to detect the behaviors as well as what drives those behaviors (i.e., the underlying motivations). Questions of importance become: What behaviors are being performed and by whom? How likely are people to indicate, if asked, whether or not they are doing particular non-compliant behaviors, and can these responses be trusted? What data sources already exist that can help to inform managers of the situation? Can monitoring the severity of impacts on resources tell managers anything about what behaviors are being performed and to what degree? Gavin, Solomon, and Blank (2010) identified eight different methods for detecting a range of non-compliant behaviors that occur globally. These methods include the use of law-enforcement records, self-reporting, indirect observation, direct observation, indirect questioning, direct questioning, forensics, and modeling. Each of these methods has its own strengths and limitations. Using a combination of techniques is suggested in order to improve detection accuracy and reduce biases that may exist with individual methods. We briefly outline the techniques that would be most useful given the context of managing non-compliance within NPS units<sup>2</sup>, including the benefits and limitations of using these methods. During the interviews with Park Service staff, law-enforcement records, direct and indirect observation, and direction questioning were indicated as methods that have been used or could be used in the future at either regional/national-levels or particular park locations.

### Law-enforcement Records

Natural resource agencies, including NPS, often maintain records collected by law enforcement personnel pertaining to arrests, warnings, violations of resource-use regulations, and seizures of illegal products. These records can provide a wealth of information regarding the types of infractions that occur, when the managing agency consistently enforces behavior and collects specific types of data in these records. Examples of information that could be collected include: locations where the incident occurred (for geospatial analyses), sociodemographic characteristics of the perpetrator(s), targeted resources and estimates of the quantity of take or damage, and time of day/week/month/year that the behavior occurred. Despite the need to collect such information and low burden on agencies (for agencies where law enforcement is in place), limitations do exist. For example, Park Service staff and our own analysis of existing law enforcement records indicated that those records do not always contain important detail-rich data. Law-enforcement records are also constrained to places that have available enforcers and to infractions that are observable (e.g., one must be “caught in the act”). Although an increase in the number of patrols can reduce non-compliant behaviors due to the

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<sup>2</sup> We exclude a discussion of self-reporting, forensic studies, and modeling. People are unlikely to accurately report the non-compliant behaviors they perform (except in rare cases), resulting in this approach being highly-biased with low utility for NPS. Modeling requires highly-specialized analytical skills and software, and is best used along with other approaches. Forensic studies are extremely labor- and resource-intensive, and require goods to be seized from the perpetrator(s). Although appropriate for use with specific types of non-compliance (e.g., poaching and other forms of illegal take), we do not discuss its use in this review. See Gavin et al., 2010, for more details on all 8 approaches.

increased risk of getting caught (e.g., greater enforcement reduced poaching; Leader-Williams & Milner-Gulland, 1993), these patrols can also lead to “increased” rates of non-compliance because there is a greater probability of being detected.

Additional variables of importance to law-enforcement records include the number of patrols conducted, the number of personnel per patrol, the area covered by patrols, and the time spent on patrols (Holmern et al., 2007), as well as the efficacy of the patrol (e.g., past training, patrol resources such as vehicles) (Hilborn et al., 2006). This type of information will help to determine whether rates of non-compliance are due to the implementation of interventions or the effectiveness of that intervention. As one NPS interviewee stated, “Sometimes the younger law enforcement personnel have new ideas and more energy to deal with non-compliance, while other times a younger person may think they know everything and get proven wrong.” This comment reflects the potential variation in how enforcement personnel interact with the public that would be important to capture as useable data – what works and what doesn’t when confronting non-compliance.

### **Indirect Observation**

There is often evidence left behind when people perform non-compliant behaviors, and such evidence can be witnessed by NPS staff, volunteers, law enforcement, or even other visitors or park neighbors. This type of indirect observation is an important source of data collection, as it can help to detect what types of behaviors are occurring and where. This approach also has relatively low demand on labor, technology, and training resources. One NPS interviewee indicated that there may be an opportunity to use Geographic Information Systems (GIS) data to explore certain types of non-compliance, such as off-highway and off-road vehicle use, when this type of behavior creates significant (observable) damage to resources. Several interviewees indicated that resource damage inventories would also provide information as to the impact of non-compliance on natural resources. Another interviewee described how maintenance records may be an additional source of information related to indirect observation; these records contain data related to the amount of money and time invested to repair park infrastructure when certain types of behaviors occur (e.g., graffiti). Indirect observation is constrained by detectability; the non-compliant behaviors must be observable. Also, information related to who is performing behaviors and *why* they are performing those behaviors is more difficult to collect with this approach. As with law enforcement records, a protocol should be in place indicating exactly what data should be collected so that the data is consistently recorded and useable for analysis.

### **Direct Observation**

Directly observing violators is another useful method to assess non-compliance. For example, managers may know of a particular spot where a non-compliant behavior is often performed, and researchers can be placed there to ascertain the sociodemographics of who uses the spot, who is or is not performing the non-compliant behavior, and other characteristics of the location or time/day on which the behaviors are performed. This approach has relatively lower bias than some approaches (e.g., direct questioning), because the researcher collecting data is directly observing and recording behavior(s). However, one limitation of direct observation is that information as to why people are performing the behavior(s) is not easy to obtain. Additionally, potential violators may stop the

behavior they would otherwise perform if they are aware of the presence of the researcher (people don't want to get caught). Another limitation to this approach is that researchers are only likely able to cover certain times and places where behaviors are being performed (rather than all places and times), and must account for this in their estimates.

### **Indirect Questioning**

The method of questioning people indirectly was designed to improve the accuracy of responses to sensitive questions and reduce bias. With indirect questioning, respondents are presented a series of possible options by which to reply, and probability theory based on those responses is then used to estimate the percentage of people who perform the behavior in question. Specifically, two techniques have been employed to assess non-compliant behaviors: the randomized response technique (RRT) and the unmatched count or item-count technique (UCT). Developed by Warner (1965), RRT introduces a randomized activity, such as a coin toss, into a session with a sample of people representing the population of interest. Each person then has the option to indicate he/she received a heads on the coin toss or performed the behavior in question, and the interviewer will not know to which question the person is responding (i.e., there is no way to implicate the respondent). Since the probability of having a heads on the coin toss is known, the researcher can calculate the probability that the behavior was performed in the sample (e.g., Solomon et al., 2007; Blank & Gavin, 2009). The UCT, introduced by Raghavarao and Federer (1979), randomly splits a sample of people into two groups: the control group and the experiment group. The control group is given a series of easy-to-answer statements (e.g., "I went to the Visitor Center"), and the experiment group is given the same series of statements with the addition of a statement containing the item of interest (e.g., "I took petrified wood from the park"). Each person from each group gives the total number of statements he/she did, and the difference between the groups divided by the sample size indicates the percentage of people who performed the behavior in question.

### **Direct Questioning**

Directly asking potential perpetrators about the behavior(s) they perform can provide a wealth of information to managers who wish to curb these activities. For example, collected information may include *who* performed the behaviors (i.e., sociodemographics), *what* behaviors they performed, the potential motivations behind *why* they performed particular behaviors, and *where* they performed the behaviors. This particular approach is most useful when interviewees trust who is interviewing them, and when the questionnaire is designed to have sensitive questions at the end (Catania et al., 1996). However, direct questioning can be highly subjective, as interviewees do not wish to implicate themselves or others they know. Additionally, some interviewees may tell only what they expect the interviewer wants to know, regardless of whether it is accurate or not (Catania et al., 1996). Direct questioning is best conducted by trained professionals (e.g., social scientists, university researchers) who have no direct link to enforcement officers. Additionally, a wide variety of informants is necessary for reliability of the information collected, and therefore, this method can be quite labor intensive.

## **Strategies to Address Non-compliant Behaviors**

In order to reduce the impacts of non-compliant behavior, natural resource managers employ a number of direct and indirect techniques (Gramann & Vander Stoep, 1987). Direct management action, such as restricting access and enforcing behavior, aims to stop behaviors from occurring immediately. Indirect management action, such as information/education, persuasion, and social marketing, is aimed at impacting factors (e.g., attitudes) that lead to the decision to perform behavior (Manning & Anderson, 2012). The effectiveness of such techniques relies on accurate identification of the behaviors and the underlying motivations driving those behaviors. Pertinent questions include: What is the intended outcome of addressing a specific non-compliant behavior? Is it to increase manager understanding of why specific behaviors are performed? Or can behaviors be modified without necessarily increasing manager understanding? Furthermore, is there an interest in increasing the understanding of the people who are performing the behaviors on why they should not do so, or does the behavior just need to be stopped? For example, social trails may result in harassment of endangered bird species in a sensitive nesting area, and short-term enforcement may be necessary to prevent such behavior. Gaining understanding as to what promoted the use of this social trail (e.g., poor resource design, desire for water-front access, lack of visitor awareness) may be necessary over the long-term to ensure other social trails are not formed or use of the original social trail does not resume once enforcement ceases. In contrast, visitors may be creating social trails throughout a park in addition to performing other non-compliant behaviors, and managers may need to focus on engaging different audiences and changing their attitudes to increase those visitors' understanding of why such rules are being implemented (there is clearly a more fundamental problem than a lack of awareness in this scenario). We discuss below some primary mechanisms for addressing non-compliant behaviors.

### **Information and education**

Most resource managers faced with handling non-compliant behaviors would prefer to use techniques that do not impede on humans' experiences (Manning & Anderson, 2012). Information and education, therefore, are favored ways to address behaviors that negatively impact natural resources, because they encourage freedom-of-choice rather than impose restrictions (Falk, 2005; Orams, 1996). The effectiveness of information and education tactics, however, is dependent on the type of behavior being performed and who is performing the behavior. Specifically, information and education are not likely to be effective with unavoidable or deliberately performed illegal actions, but may be effective with unskilled and uninformed actions (Manning & Anderson, 2012). For example, information and education can work in situations where visitors are relatively unaware of appropriate norms or do not have underlying motivations for performing non-compliant behaviors (Orams, 1996). Such approaches may be particularly effective for encouraging compliance and fostering greater trust in the managing institution if conducted in a welcoming way (Tardona, 2012). For example, one NPS interviewee indicated that park employees or volunteers who patrol a trail and offer cloth leashes and treats to people with off-leash dogs along that trail may have much greater success as getting dogs on-leash than would law enforcement patrols. This type of friendly, one-on-one interaction with employees/volunteers can help model appropriate behavior and be used to inform dog-walkers of the impacts their dogs can have on local wildlife and resources. Other sources

of information and education can be signage, kiosks, and brochures, or specific programming and communication techniques such as campfire talks, interpretive talks, and radio/media bits.

## **Persuasion**

Persuasion efforts focus on understanding *why* people are motivated to perform specific behaviors, with the expressed intent of affecting or changing people's attitudes. Persuasion, therefore, aims to convince individuals of the underlying reason(s) for performing or not particular behaviors. For example, rather than posting a sign saying "Area closed" (i.e., information sharing), a persuasive technique might inform people that "Future forests are growing here" or that it is a "Tick-infested area" in an effort to keep them out. The goal in this example would be to change someone's attitude regarding the closure of a particular area to an attitude of support for the management action or one of disgust for potential negative consequences suffered (e.g., being bitten by ticks) if the sign is ignored.

According to theory, there are two routes to effective persuasion – one is central, the other peripheral (Petty & Cacioppo, 1986). In the central route, persuasive appeals require higher cognitive deliberation due to the more complex nature of the appeals. The effects of persuasive techniques invoking this central route can be longer lasting because people spend time thinking about, or deliberating, the content of the message. Such messages, however, may be considered too complex and, as a result, be ignored by people who are not interested in thinking about the content of the message. In the peripheral route, persuasive appeals rely heavily on social cues, such as the charisma or authority of the speaker/information source and the message delivery. This route can be more effective in situations where individuals are *not* likely to spend time deliberating the message, because they are instead influenced by who delivers the message and how. Conversely, these messages may be less effective if the source or medium is not considered influential, respectable, or otherwise worthy of being heard. Sam Ham and his colleagues (2008), who studied ways to persuade visitors to increase compliance rates related to littering, feeding wildlife, and walking dogs off-leash in protected areas, found that the peripheral-route of persuasion occurred more often than the central-route across their studies. Their findings indicated that short-term behavior change was achieved, but people's overall beliefs were not impacted. These results indicate that visitors performing specific behaviors onsite are less inclined to process persuasive appeals through central-routes. Furthermore, their results suggest that onsite persuasive appeals are less effective at *changing* attitudes, but they may be useful for invoking known attitudes (e.g., people dislike ticks, and a sign indicating a tick-infested area may keep people out).

## **Social marketing**

Social marketing, also referred to as community-based social marketing, is another technique that can be employed to influence decision factors leading up to the performance of non-compliant behaviors. This approach relies on marketing principles traditionally used to entice people to purchase products, but are instead applied to encourage behaviors that benefit the public good or discourage particular behaviors such as those that are non-compliant. Social marketing relies on social norms, focuses on group-level impacts and behaviors, and seeks to identify barriers that prevent behavior change using tenets of social psychology (Andreason & Kotler, 2008; McKenzie-Mohr, 2011; McKenzie-Mohr,



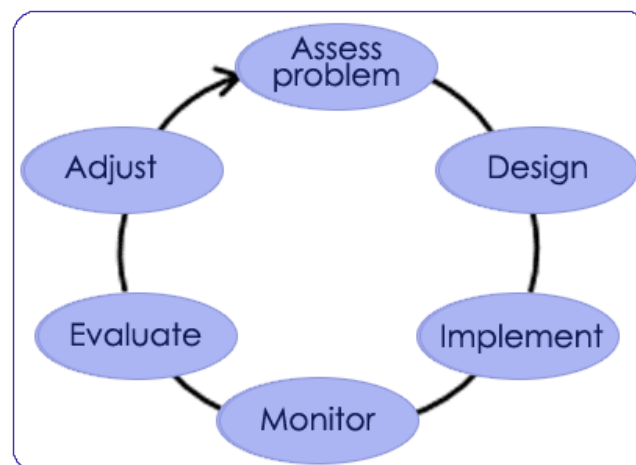
Lee, Shultz, & Kotler, 2012). Using this model, behaviors are prioritized by determining which has the greatest negative impact and greatest likelihood of change (i.e., “behavioral plasticity;” Schultz, 2011). Such an approach would help managers to figure out the best course of action related to reducing negative impacts on natural resources. Specifically, if a particular behavior is having the greatest degree of damage to a protected area and many visitors are performing this behavior, then both of these conditions would be met and social marketing would have the greatest likelihood of success in changing behaviors. Alternatively, if a population of visitors is having a less significant impact, but a high likelihood of changing their behavior exists (more so than another population that is *not* willing to change their behavior), then this particular group should be targeted to ensure utmost effectiveness of interventions. Essentially, social marketing can help managers identify which behavior and audience would best be targeted to reduce non-compliant behaviors. Several international case studies display the effectiveness of social marketing in influencing conservation-related behaviors: <http://www.conservationevidence.com/collection/25#spec>.

## **Enforcement**

Enforcement, such as patrolling an area and issuing tickets or fines through the use of trained personnel, is a direct method commonly used to thwart deliberately performed illegal behaviors. There are multiple dimensions to an enforcement model, including one’s perceived chance of getting caught, attitude toward the fine or punishment, and the perceived legitimacy of the regulations and regulating authority, all of which can lead to different interventions (e.g., the use of more personnel or higher fines). Enforcement immediately impacts the individual(s) performing the behavior, and can be quite successful at reducing rates of non-compliance. For example, compliance rates in fishing communities increased in tandem with rates of enforcement as opposed to when fines were increased (Sutinen & Gauvin, 1989; Furlong, 1991). However, enforcement is only successful when the violator is caught, and the probability of detection can be extremely low in parks and protected areas (Carlough, 2003; Nagin & Pogarsky, 2001). When people perceive the chances of getting caught to be low, non-compliant behaviors often occur or continue to persist (Nielsen, 2003). Research also indicates that targeting certain behaviors, such as the *selling* of illegally-hunted species, for enforcing fines and sanctions are more effective than directly fining or sanctioning the group that collected the species (e.g., hunters) (Damania, Milner-Gulland, & Crookes, 2005; Clayton, Keeling, & Milner-Gulland, 1997). This approach works because it impacts the buyer/seller relationship directly on the market rather than targeting the individuals supplying the goods: as long as there is someone wanting to buy, then a supplier will likely surface. Enforcement, although highly successful, is by far the most direct and resource-intensive method for controlling non-compliant behavior, which can result in its use being relegated to scenarios of extreme resource damage or situations in which human safety is at risk (i.e., “actions against humanity” such as arson, human trafficking, or domestic violence).

# Managing Non-compliance with an Adaptive Management Framework

A majority of non-compliance issues are not readily understood, making it difficult to determine the most appropriate solutions to curbing inappropriate behaviors. Understanding what behaviors are occurring, what drives particular behaviors, and how to monitor those behaviors are necessary components to effectively initiate and carry out the proper response(s). Managers who rely on assumptions about why people are performing particular behaviors rather than undertaking any sort of data collection may apply interventions that don't match the underlying motivations or are too briefly implemented. Furthermore, it is not enough to implement a solution with little regard to its effectiveness over time. Managers must consider their objectives and set them early on: is the goal to change behavior short-term while visitors are onsite or affect attitudes over the long-term? Do managers need to increase their own understanding of the situation or curb behaviors immediately to protect an endangered species? Uncertainty is also an inherent part of managing non-compliance, as the state of the resources being affected by human behaviors is always changing and the people performing behaviors are influenced by many factors that may be outside of resource managers' control. This inherent uncertainty in the process of managing non-compliance underscores the importance of having a solid framework from which to work over time. With this in mind, we suggest applying an adaptive management framework to non-compliance. Adaptive management suggests that management of uncertain conditions is best suited to a learning-oriented feedback loop; managers must first assess the problem, then design a way to investigate and solve the problem, implement a solution to that problem, monitor the situation and evaluate the effectiveness of that solution, and adjust the process as necessary (see figure 1; Williams, Szaro, & Shapiro, 2009). One of the most important components of the adaptive management framework is monitoring: progress occurs through continual updating and reassessment of the situation based on feedback gained from monitoring of responses to the implemented solutions.



**Figure 1.** Diagram of the DOI adaptive management framework that can be applied to understand and address non-compliance (Williams, Szaro, & Shapiro, 2009).

This type of framework is an excellent tool for managing non-compliance. In the first step, the manager or team working on the issue at hand identifies the critical threats that are being faced (e.g., habitat destruction, wildlife harassment), the contributing behaviors and groups of people performing the behaviors, and the range of potential underlying motivations via available data sources (i.e., managers should *not* rely on their own hunches or those of others). It is quite possible that data must be collected first to adequately assess the problem. To further underscore the range of underlying motivations that can be influencing behaviors, the types of data collection that might best be used for different motivations, and which solutions have been implemented in the past, we developed table 3. This table was informed by interviews conducted with NPS staff, as well as available literature, and represents some common examples of non-compliant behaviors that were described as being performed on park units. Many more examples of non-compliant behaviors exist, and not all motivations, data collection methods, or solutions for addressing behaviors are represented in the table. We also stress the importance of working with a social scientist on these issues, because many times the relationships between these categories are complex and inter-related. The first step of the adaptive management framework is by far the most critical, as the resulting steps rely on an accurate assessment of the problem. Accuracy and care given to the first step will ensure that the rest of the process has a better chance of success.

**Table 3.** Examples of some commonly performed non-compliant behaviors, as reported during interviews with NPS staff, including potential drivers of those behaviors, methods for detecting behaviors, and strategies for addressing those behaviors.<sup>1</sup>

<b>Types of Non-compliant Behaviors (specific examples in parentheses)</b>	<b>Drivers (motivations of behaviors)</b>	<b>Detection of Behaviors<sup>2</sup> (data collection methods)</b>	<b>Strategies Employed (management responses)</b>
Failure to stay on authorized trails or roads			
<i>Social trails</i>	Uninformed (e.g., lack of obvious trail, no signage) Releaser-cues (e.g., cairns, natural attractants such as waterfalls and scenic views)	Indirect observation (e.g., resource monitoring for areas of large impact) Direct observation (e.g., GPS tracking of visitors)	Persuasion (e.g., signage) Enforcement Restrict access to guided trips Phone apps that can denote appropriate places to hike
<i>Unauthorized off-highway vehicle use</i>	Attitudes (e.g., entitlement, lack of respect for authority) Social norms (e.g., friends and/or family are doing it)	Indirect observation (e.g., resource monitoring with the use of GIS layers)	Social marketing Enforcement Block access with fences
Taking of, killing, or destroying resources			
<i>Poaching wildlife</i>	Economic/profit motive Subsistence Releaser-cues (e.g., trophy elk is “prized” by others)	Indirect observation (e.g., resource monitoring) Indirect questioning	Enforcement Persuasion (e.g., signage)
<i>Collecting plants/edibles</i>	Economic/profit motive Uninformed (e.g., recent immigrants) Cultural incentives	Indirect observation (e.g., resource monitoring) Indirect questioning	Enforcement Social marketing with target audiences Persuasion (e.g., signage)
Improper practices			
<i>Dumping of hazardous materials</i>	Low probability of detection Convenience	Indirect observation (e.g., resource monitoring)	Persuasion (e.g., signage) Enforcement
<i>Releasing exotic animals</i>	Releaser-cues (e.g., believe animals “belong outside”)	Direct questioning Indirect questioning	Social marketing with target audiences Phone apps to assist with early detection of species
Incompatible uses			
<i>Dogs off-leash</i>	Releaser-cues Attitudes (e.g., entitlement)	Direct observation Direct questioning	Volunteer patrols Social marketing
<i>Public indecency (e.g., drug use, excessive drunkenness, sex acts)</i>	Attitudes (e.g., entitlement, lack of respect for authority) Personal enjoyment	Direct observation Direct questioning Indirect questioning	Patrols/enforcement

**Table 3, continued.** Examples of some commonly performed non-compliant behaviors, as reported during interviews with NPS staff, including potential drivers of those behaviors, methods for detecting behaviors, and strategies for addressing those behaviors.<sup>1</sup>

<b>Types of Non-compliant Behaviors (specific examples in parentheses)</b>	<b>Drivers (motivations of behaviors)</b>	<b>Detection of Behaviors<sup>2</sup> (data collection methods)</b>	<b>Strategies Employed (management responses)</b>
Inappropriate human-wildlife interactions			
<i>Feeding/approaching wildlife</i>	Emotion (e.g., awe, attraction) Uninformed (e.g., of danger) Releaser-cues (e.g., the animal is "right there")	Direct observation Direct questioning Indirect questioning	Signage Social marketing
<i>Disturbance of sensitive nesting areas</i>	Releaser-cues (e.g., natural attractants such as ocean or climbing area) Attitudes (e.g., entitlement)	Direct questioning Direct observation Indirect observation (e.g., resource monitoring)	Signage Block access with fences Social marketing

<sup>1</sup> This table is not intended to be comprehensive, nor prescriptive. What drives behaviors, how to detect those behaviors, and ways to address those behaviors can vary considerably depending on context of the situation. Furthermore, an understanding of the relationships between these categories through the use of social science is critical to informing the success of potential solutions. For example, drivers listed here are not based on data collection specifically focused on assessing drivers as described by those performing the behaviors. Additionally, NPS staff were not asked to match each of these categories for every behavior described, so many more examples exist than what is listed here. For more information regarding the interviews with NPS staff, see Appendix A.

Once the problem at-hand is identified, the second step is to design a way to monitor the situation. This particular step of “design” can include the use of additional data collection methods, such as direct questioning of a group of visitors to assess attitudes toward the proposed intervention or indirect observation of a place that is being heavily impacted. Consulting with a social scientist familiar with the type of solution being implemented can be a critical part of this process, or consultation could help to identify which response might best be operationalized given the particular scenario. The third step includes implementation of the previous step, meaning that a work plan, timeline, and budget for monitoring the situation must all be identified. The fourth step includes actual collection of data during the monitoring phase that will be used to assess the effectiveness of implemented solutions. Monitoring is a critical component of managing non-compliance, because many things can change during the process. Data collecting during this step must also be prepared and analyzed, so continued collaboration with social science researchers trained in such methods would be ideal. With results of the data collection, the next step of evaluation can occur. Did the behavior stop or is it now being performed in another part of the park? Did the motivations for performing particular behaviors change once the intervention was implemented? Was an additional problem created by this process? A key part of the adaptive management framework is to adjust, if results of monitoring efforts indicate that the intervention was unsuccessful or created a new problem.

As denoted by this framework, the process is cyclical and repeating of steps is necessary and ongoing. For instance, if the intervention was unsuccessful, then each step must be re-evaluated for what went awry. Perhaps the critical threats were not properly identified, monitoring was not conducted according to the plan, or the timeline was not sufficient. Each step is a critical piece of effectively managing non-compliance and must be given due attention throughout the process.

## Conclusion

Non-compliant behaviors are clearly a concern when managing parks and protected areas. Human behaviors have a wide-range of negative impacts on natural resources and are motivated by a variety of reasons, making them difficult to address. Furthermore, the ways in which managers can respond to non-compliant behaviors are not always equally effective or long-lasting. The use of multiple strategies to reduce non-compliant behaviors is often warranted, largely because different people may be performing the same behavior for different reasons (Johnson & Vande Kamp, 1996). The use of an adaptive management framework can greatly aid in the reduction of impacts caused by non-compliant behaviors, because such a framework incorporates elements of uncertainty, creates a feedback loop from which to effectively monitor the situation and adjust as necessary, and highlights the importance of re-evaluating the effectiveness of solutions that are implemented. With continued monitoring and assessment of the situation, managers can adequately respond to the complexity of non-compliance. And finally, through sharing of information gained by using such adaptive processes, managers will have a better sense of the most effective solutions for curbing non-compliance.





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## **Appendix A. Methods Used to Conduct NPS Staff Interviews**

**Methods:** Sixteen semi-structured interviews were conducted by telephone with National Park Service (NPS) staff between November 2013 and February 2014. NPS project leads initially contacted staff by email, and Colorado State University (CSU) conducted subsequent contacts with identified staff by email and telephone. CSU conducted the interviews by telephone, which lasted approximately 60 minutes in length with some interviews lasting up to 90 minutes. Interviews were captured via note-taking on computer during the telephone call rather than by actual recording of conversations. Examples of interviewees' comments divulged during the interviews are provided in the main body of this document, where appropriate. While these should not be considered verbatim wording of any one respondent, as no recording device was used, the comments adhere to the meaning and context of the speaker's original statements. Respondents also received an interview guide with probing questions prior to the interview, and those questions (along with associated follow-up questions) were used as prompts during the actual interview.

**The following NPS divisions, programs, and offices were represented:**

- Alaska Regional Support Office
- Intermountain Regional Support Office
- Midwest Regional Support Office
- National Capital Regional Support Office
- Northeast Regional Support Office
- Pacific West Regional Support Office
- Southeast Regional Support Office
- Washington Support Office (WASO) – Interpretation/Education Division
- WASO – Natural Resource Stewardship and Science (NRSS)/Biological Resource Management Division
- WASO – NRSS/Environmental Quality Division (EQD)
- WASO – NRSS/EQD/Social Science Program
- WASO – NRSS/Office of Education and Outreach
- WASO – Park Facility Management Division
- WASO – Public Risk Management Program
- WASO – Visitor & Resource Protection-Law Enforcement, Security & Emergency Services



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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